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91526M

915265

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

SUPERVISOR'S USE ONLY

Ahupūngao, Kaupae 3, 2016

91526M Te whakaatu māramatanga ki ngā pūnaha hiko

2.00 i te ahiahi Rātū 15 Whiringa-ā-rangi 2016
Whiwhinga: Ono

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki ngā pūnaha hiko.	Te whakaatu māramatanga hōhonu ki ngā pūnaha hiko.	Te whakaatu māramatanga matawhānui ki ngā pūnaha hiko.

Tirohia mēnā e rite ana te Tau Ākonga ā-Motu (NSN) kei runga i tō puka whakauru ki te tau kei runga i tēnei whārangi.

Me whakamātau koe i ngā tūmahi KATOA kei roto i tēnei pukapuka.

Tirohia mēnā kei a koe te Pukapuka Rauemi L3–PHYSMR.

Ki roto i ō tuhinga, whakamahia ngā whiriwhiringa tohutau mārama, ngā kupu, ngā hoahoa hoki, tētahi, ētahi rānei o ēnei, ki hea hiahiatia ai.

Me hoatu te wae tika o te Pūnaha Waeine ā-Ao (SI) ki ngā tuhinga tohutau, ki ngā tau tika o ngā tau tāpua.

Mēnā ka hiahia whārangi atu anō mō ō tuhinga, whakamahia te wāhi wātea kei muri o tēnei pukapuka.

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2–15 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

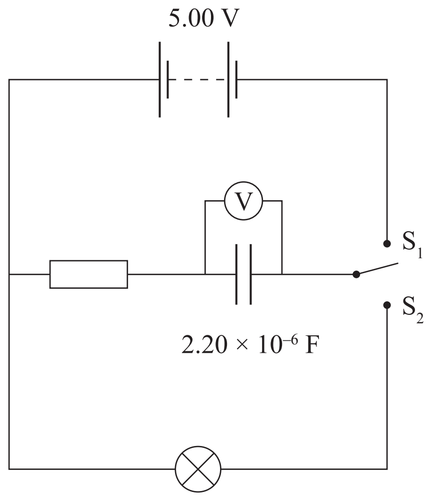
ME HOATU RAWA KOE I TĒNEI PUKAPUKA KI TE KAIWHAKAHAERE Ā TE MUTUNGA O TE WHAKAMĀTAUTAU.

TAPEKE

MĀ TE KAIMĀKA ANAKE

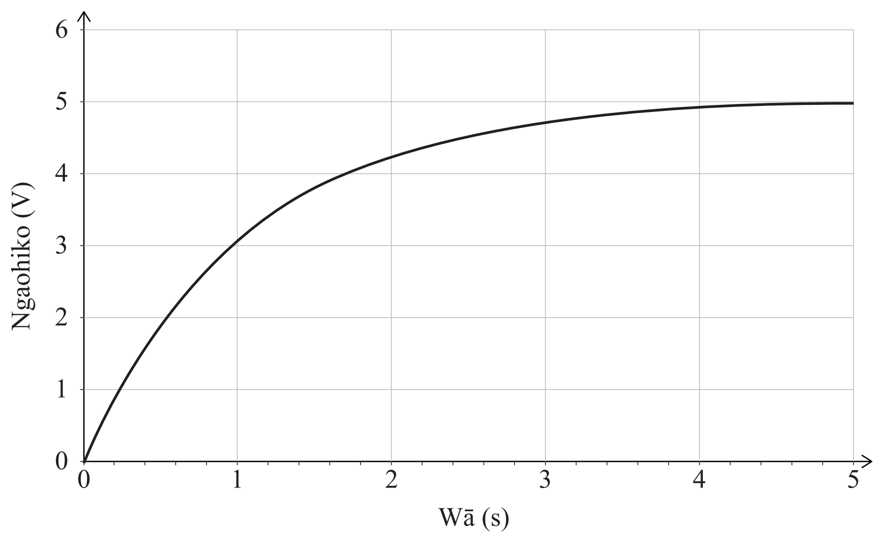
TŪMAHI TUATAHI: TE WHAKAHIKO PŪNGA IAHIKO

Ka whakatūhia e Eleanor he ara iahiko hei tūhura he pēhea te mahi a ngā pūnga iahiko. Ko te ara iahiko e whakaaturia ana i raro nei.
Kei roto i te ara iahiko ko tētahi pūnga iahiko 2.20×10^{-6} F me tētahi pana pito rua.



(a) Tātaihia te whana mōrahi e putua ana e te pūnga iahiko i roto i tēnei ara iahiko.

Kei te hiko-kore te pūnga iahiko i te tuatahi, ā, e whakaaturia ana te tūnga o te pana. Ka nekehia e Eleanor te pana ki S_1, ā, ka whakahiko haere te pūnga iahiko. E whakaaturia ana i raro te kauwhata o te ngaohiko pūnga iahiko ki te wā.



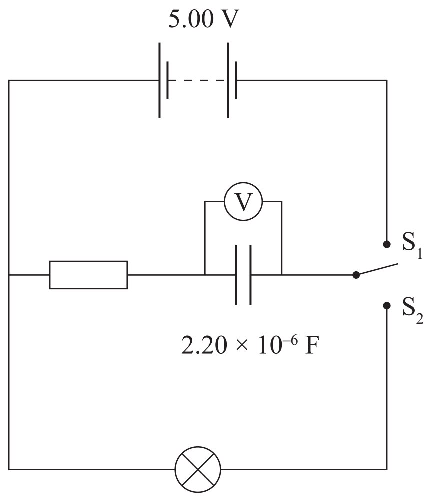
(b) Mai i te kauwhata, tātaihia te parenga o te parenga iahiko.

Tātuhia ngā rārangi ki te kauwhata hei āwhina ki te whakamārama i ō mahinga.

QUESTION ONE: CHARGING A CAPACITOR

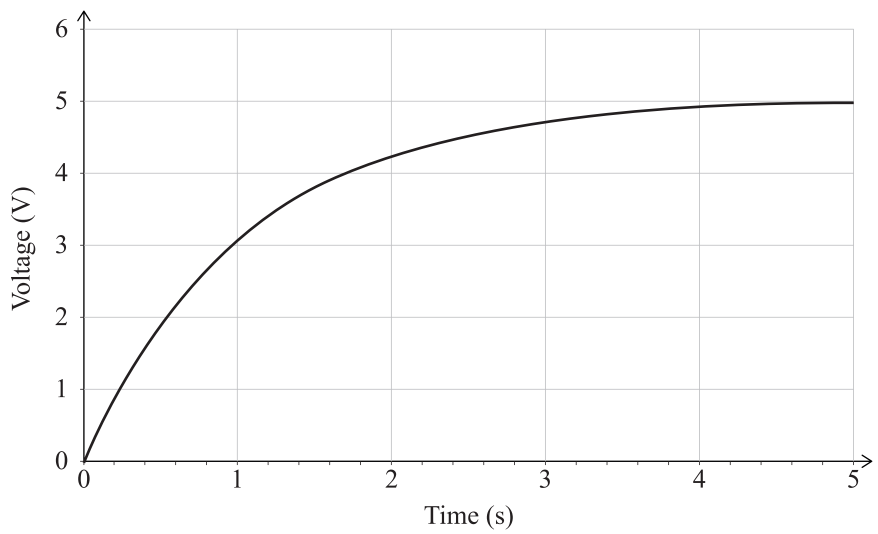
ASSESSOR'S USE ONLY

Eleanor sets up a circuit to investigate how capacitors operate. The circuit is shown below. The circuit includes a 2.20×10^{-6} F capacitor and a double pole switch.



(a) Calculate the maximum charge stored by the capacitor in this circuit.

The capacitor is initially uncharged, and the switch is in the position shown. Eleanor moves the switch to S_1 and the capacitor charges up. A graph of the capacitor voltage against time is shown below.



(b) Use the graph to calculate the resistance of the resistor.

Draw lines on the graph to help explain your working.

MĀ TE KAIMĀKA ANAKE

(c) Tuhia he whakamāramatanga matawhānui mō te āhua o te kauwhata ngaohiko o te pūnga iahiko.

Whakauruhia atu ngā take mō te ngaohiko tīmatanga me te ngaohiko whakamutunga.

(d) Ka tūhono hātepetia e Eleanor tētahi atu pūnga iahiko 2.20×10^{-6} F ki te pūnga iahiko tuatahi, ka mahia anō te whakamātautau.

Whakaahuahia me te whakamārama mai ka pēhea te pānga o tēnei ki:

- te ngaohiko whakamutunga puta noa i te pūnga iahiko tuatahi
- te aumou wā o te ara iahiko.

(c) Give a comprehensive explanation for the shape of the capacitor voltage graph.

Include the reasons for the starting voltage and the final voltage.

ASSESSOR'S USE ONLY

(d) Eleanor connects another 2.20×10^{-6} F capacitor in series with the original capacitor, and repeats the experiment.

Describe and explain how this affects:

- the final voltage across the original capacitor
- the time constant of the circuit.

TŪMAHI TUARUA: TE WHITIHIKO

Whakamahia ai ngā whitihiko hei whakapiki, whakaheke rānei i te rahinga o tētahi ngaohiko AC. He whitihiko tā Wei i hangaia hei whakawhiti i te 240 V ki te 12.0 V.

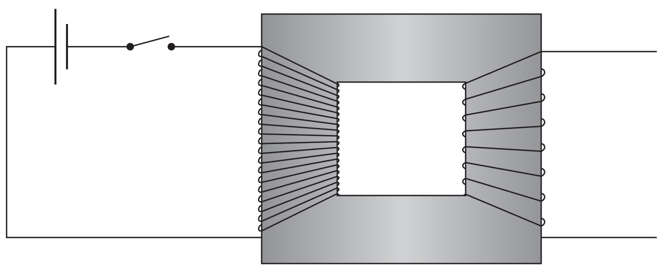
E 40 ngā hurihanga o te pōkai tuarua.

(a) Tātaihia te maha o ngā huringa o te pōkai matua.

(b) Whakamāramahia mai he pēhea te hanga a tētahi ngaohiko hohoko puta noa i te pōkai matua i tētahi iahiko hohoko i roto i tētahi pūrama e tūhonoa ana ki te pōkai tuarua.

Ka mahi ia pōkai o tētahi whitihiko hei pūkōpana (inductor).

Kei te mau tētahi pōkai matua ki tētahi pūhiko, pana hoki e ai ki te hoahoa i raro. Kei te kati te pana, ā, i muri mai ka huakina.



QUESTION TWO: THE TRANSFORMER

Transformers can be used to increase or decrease the size of an AC voltage. Wei has a transformer that is designed to convert 240 V into 12.0 V.

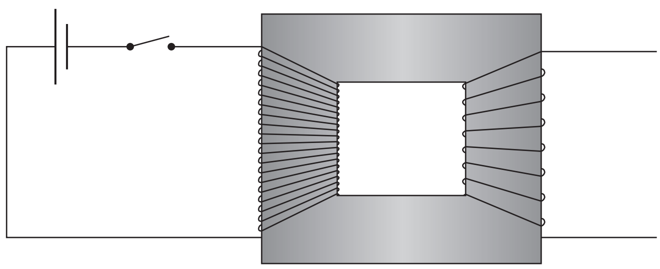
The secondary coil has 40 turns.

(a) Calculate the number of turns on the primary coil.

(b) Explain how an alternating voltage across the primary coil creates an alternating current in a light bulb connected to the secondary coil.

Each coil of a transformer acts as an inductor.

A primary coil is attached to a battery and switch as shown in the diagram below. The switch is closed and then some time later the switch is opened.



MĀ TE KAIMĀKA ANAKE

(c) Tātuhia he kauwhata e whakaatu ana he pēhea te huri o te iahiko i roto i te pōkai ina katia te pana, ā, i muri mai ina huakina te pana.

Tuhia he whakamārama matawhānui mō te āhua o tō kauwhata.

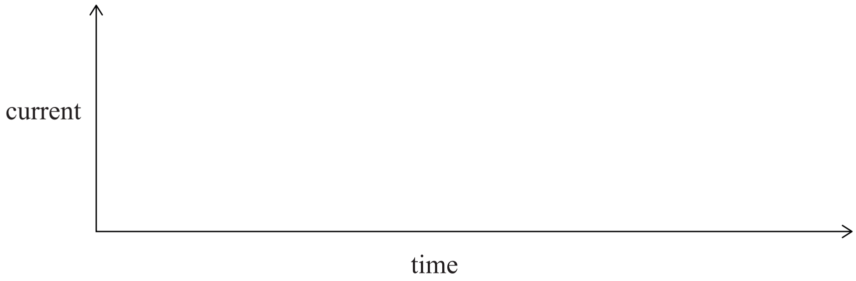
Ki te hiahia koe ki te tuhi anō i tō urupare, whakamahia te kauwhata i te whārangi 14.

(d) Tātaihia te pūngao e putu ana i te whaitua autō o te pōkai matua ina katia te pana mō ētahi hēkona.

ngaohiko pūhiko	= 6.0 V
parenga o te pōkai matua	= 35 Ω
kōpanatanga o te pōkai matua	= 0.10 H

(c) Sketch a graph showing how the current in the coil changes when the switch is closed and then some time later is opened.

Give a comprehensive explanation for the shape of your graph.



If you need to redraw your response, use the graph on page 15.

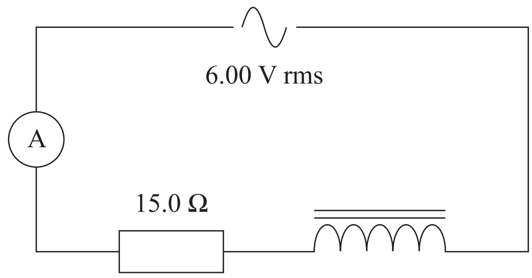
(d) Calculate the energy stored in the primary coil's magnetic field when the switch has been closed for several seconds.

battery voltage	= 6.0 V
resistance of primary coil	= 35 Ω
inductance of primary coil	= 0.10 H

TŪMAHI TUATORU: TE INE RINO I ROTO KIRIKIRI

Kei te hiahia a Vivienne ki te ine i te nui o te rino i roto i ngā ranunga kirikiri-rino mai i ngā ākau rerekē. E whakaatu ana te hoahoa i raro i te ara iahiko e whakamahi ana ia. Kei roto i te ara iahiko tētahi pōkai huri-500 me te parenga o te 15.0 Ω, me tētahi putunga AC.

Ka mahi te pōkai pēnei i tētahi parenga iahiko me tētahi pūkōpana e hātepetia ana.



He uho arenga tō te pōkai, kāore he mea i roto i te tuatahi. Ka whakatikatika a Vivienne i te ngaohiko punahiko ki te 6.00 V rms.

(a) Tātaitia te mōrahi ngaohiko inamata puta noa i te punahiko.

I te wā whakamātautau, ka raua e Vivienne he ranunga rino me te kirikiri ki roto i te uho o te pōkai.

(b) Tuhia he aha te pānga o tēnei ki te rahi o te hohenga o te pōkai.

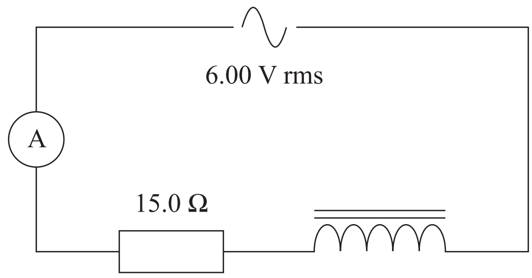
Mā te kōrero mō te haukotinga (impedance), whakamāramahia mai ka ahatia te rahinga o te iahiko i roto i te ara iahiko i a ia e tāpiri ana i te ranunga rino me te kirikiri.

QUESTION THREE: MEASURING IRON IN SAND

ASSESSOR'S USE ONLY

Vivienne wants to measure the amount of iron in iron-sand mixtures collected from different beaches. The diagram below shows the circuit that she uses. The circuit includes a 500-turn coil with a resistance of 15.0 Ω, and an AC supply.

The coil behaves like a resistor and an inductor in series.



The coil has a hollow core that is initially empty. Vivienne adjusts the power supply voltage to 6.00 V rms.

(a) Calculate the instantaneous maximum (peak) voltage across the power supply.

During testing, Vivienne puts a mixture of iron and sand inside the core of the coil.

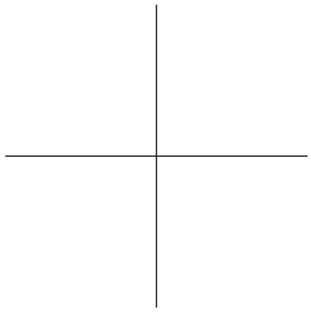
(b) State what effect this has on the size of the coil's reactance.

With reference to impedance, explain what happens to the size of the current in the circuit as she adds the mixture of iron and sand.

MĀ TE KAIMĀKA ANAKE

(c) Ina whakaritea e Vivienne te auautanga o te iahiko ki te 1.00×10^{3} Hz, ko te kōpanatanga o te pōkai he 3.18×10^{-3} H.

Mā te whakamahi i te hoahoa perehuri (phasor), tētahi atu rānei, tātaihia te rahi o te iahiko rms i roto i te ara iahiko.



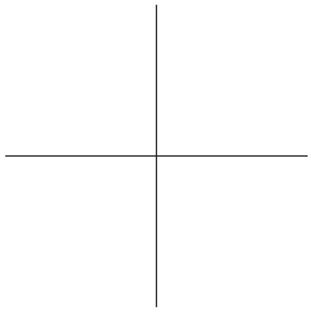
(d) Ka tāpirihia hātepetia e Vivienne he pūnga iahiko ki te pōkai, ka kite ia ka piki te iahiko.

Whakamāramahia mai he aha i piki ai te iahiko.

ASSESSOR'S USE ONLY

(c) When Vivienne sets the frequency of the current to 1.00×10^{3} Hz, the inductance of the coil is 3.18×10^{-3} H.

Using a phasor diagram or otherwise, calculate the size of the rms current in the circuit.



(d) Vivenne adds a capacitor in series with the coil, and finds that the current increases.

Explain why the current increases.

MĀ TE KAIMĀKA ANAKE

HE HOAHOA WĀTEA

Ki te hiahia koe ki te tātuhi anō i tō urupare ki te Tūmahi Tuarua (c), whakamahia ngā tuaka i raro nei. Kia mārama te tohu ko tēhea te urupare ka hiahia koe kia mākahia.

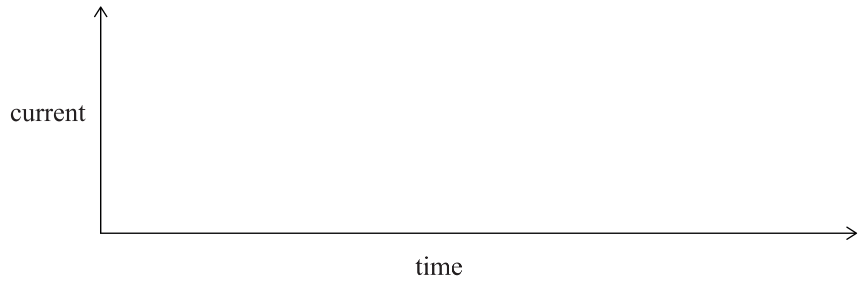
He whārangi anō ki te hiahiatia.
Tuhia te (ngā) tau tūmahi mēnā e tika ana.

TAU TŪMAHI

ASSESSOR'S USE ONLY

SPARE DIAGRAMS

If you need to redraw your response to Question Two (c), use the axes below. Make sure it is clear which answer you want marked.



Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

English translation of the wording on the front cover

Level 3 Physics, 2016

91526 Demonstrate understanding of electrical systems

2.00 p.m. Tuesday 15 November 2016
Credits: Six

91526M

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of electrical systems.	Demonstrate in-depth understanding of electrical systems.	Demonstrate comprehensive understanding of electrical systems.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Make sure that you have Resource Booklet L3–PHYSMR.

In your answers use clear numerical working, words and/or diagrams as required.

Numerical answers should be given with an SI unit, to an appropriate number of significant figures.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–15 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.